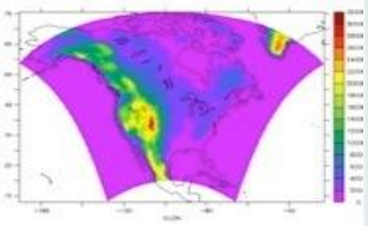


The NCAR Climate Risk Management Engine (CRMe)

Jonathan L. Vigh (NCAR / RAL)

Caspar M. Ammann (NCAR / RAL)

Jared A. Lee (NCAR / RAL)

Philippe Naveau (LSCE / CNRS)

12SOCIETY at 97th AMS Annual Meeting ◆ Talk 3.5 ◆ 24 Jan 2017 ◆ Seattle, WA

Overview

1. **Growing challenges for decision-makers today**
   - threats from weather and climate variability: events
   - evolving questions about climate change

2. **The need for going beyond data and information**
   - data and information portals & the lack of addressing specific needs
   - tailoring and translation to put information into proper context

3. **Examples of approaches and tools to build relevant knowledge and to enable the development of solutions**
   - *top-down* data and information (portals)
   - *bottom-up* requirements and challenges (requests)
   - Co-development concept: embedded capacity building
   - Screening tools and dashboards: Informing decision processes

Events in the news: climate variability or change?

Flood / Landslides

Droughts / Crop Failure

A worke
exports
Cecafe,
Patricia M

Pests / Diseases

Climate Impact Studies — Current Climate Data Libraries

IPCC AR4 (2007)

IPCC AR5 (2013)

IPCC AR6 (2019?)

Total: 35 TB

Total: 2,200 TB (Petabyte)

Expected: 0.2–1 Exabyte

… not just data and information …

a picture is more than pixels

Water: Precipitation ≠ Precipitation

Application-specific understanding and evaluation needed

Itaipu : Hydropower

Mexico : Drought

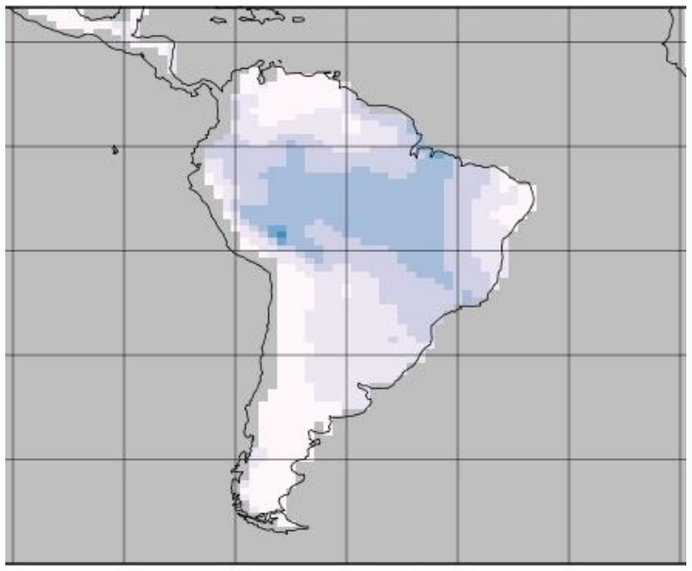
Panama : Flash Flood

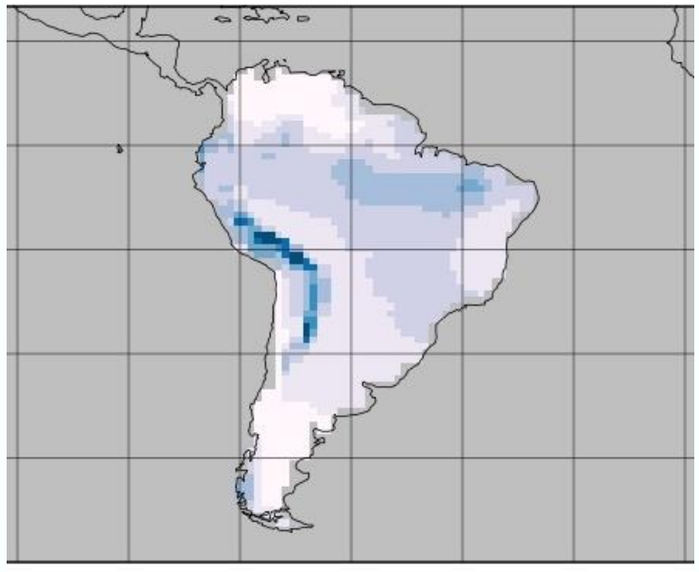
Haiti : Hurricane

New Tools to Evaluate Models and Data: MET/MODE

Field: pr(DJF)

Mean (mm)

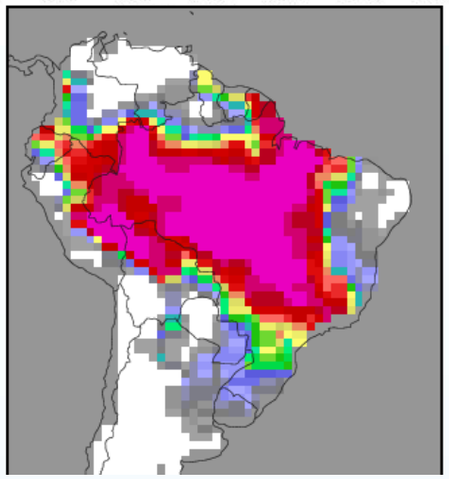


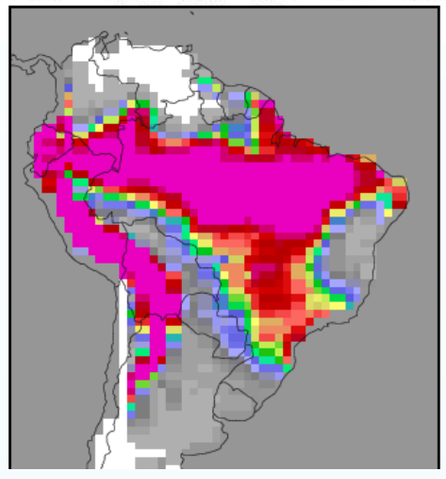


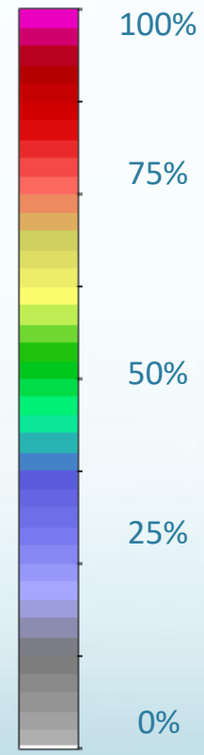
Observations
CRU TS3.21

Models
CESM-LE

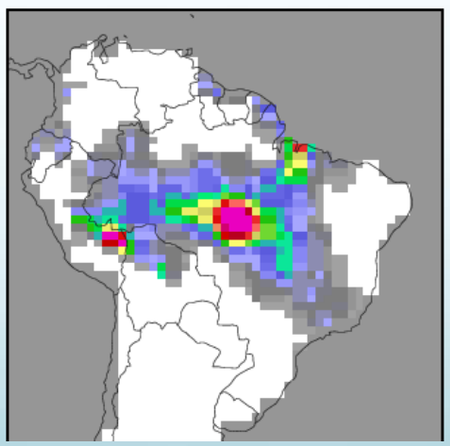
Object frequency
>500mm

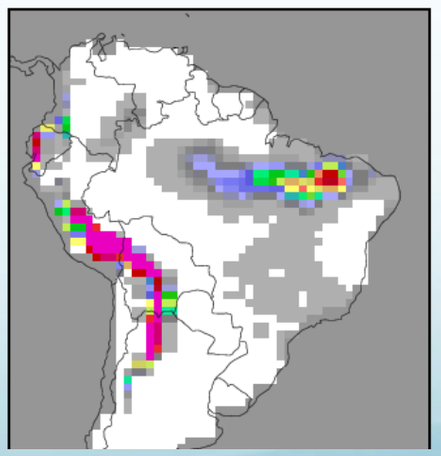






Object frequency
>900mm





IFC International Finance Corporation WORLD BANK GROUP

ABOUT IFC SOLUTIONS SUSTAINABILITY NEWS & EVENTS RESOURCES

Example: Climate Change Screening

CLIMATE BUSINESS

OVERVIEW

Working Draft

Pure Financial Loss	Pecuniary	BBB/Crime	Credit	Surety bonds	Cyber	Legal expenses		
Liability	Professional Liability (inc. medical malpractice and D&O)	Third party liability	General	Products	Personal			

[Brief description then summary table which is the filtered list of sub-business lines based on the material relevance of each sub-business line to climate risk. These are the sub-business lines which will feature in the screening tool].

				Storm				Flood			Extreme temperature		Drought	Wild fire
Business line	Clientele	Business sublines	Relevance to climate change/ weather events	Tropical storm	Extra-tropical storm	Local/ convecti	General/ river flood	Storm surge/	Heat wave	Cold wave	Drought	Forest/ land fire
Accident and Health	Corporate	Accident insurance	Yes	M	M	M	M	M	No	No	No	No
Accident and Health	Corporate	Health insurance	Yes	L	L	L	L	L	M	M	No	No
Agricultural	Corporate	Crop	Yes	H	H	H	H	H	H	H	H	H
Agricultural	Corporate	Livestock	Yes	H	H	H	H	H	H	H	H	H
Agricultural	Corporate	Weather Index Insurance	Yes	H	H	H	H	H	H	H	H	H
Aircraft	Corporate	Airports, crafts	Yes	M	M	M	L	L	No	No	No	L
Construction	Corporate	Construction all risk	Yes	H	H	H	H	H	M	M	No	No
Construction	Corporate	Erection all risk	Yes	H	H	H	H	H	M	M	No	No
Energy	Corporate	Offshore and onshore	Yes	H	H	H	H	H	No	No	No	No
Hull	Corporate	Goods in transit	Yes	H	H	H	No	No	H	No	No	No
Motor	Corporate	Motor	Yes	H	H	H	H	H	H	No	No	No
Property	Corporate	Business interruption	Yes	H	H	H	H	H	H	No	No	No
Property	Corporate	Fire and other hazard effects	Yes	H	H	H	H	H	H	No	No	H
Travel	Corporate	Travel	Yes	H	H	H	H	H	H	L	L	No	No
Accident and Health	Personal	Accident insurance	Yes	M	M	M	M	M	M	No	No	No	No

	FUTURE climate regime for a storm surge level equivalent to the 20-year return period in the baseline climate regime.	1 in 20
Change in 50-year return period of storm surge risk	The annual exceedance probability of the specified FUTURE climate regime for a storm surge level equivalent to the 50-year return period in the baseline climate regime.	1 in 50
Change in 100-year return period of storm surge risk	The annual exceedance probability of the specified FUTURE climate regime for a storm surge level equivalent to the 100-year return period in the baseline climate regime.	1 in 100
Heat wave	HeatWaveDays: Average number of days per year in which the daily mean temperature exceeds the 90th percentile daily mean temperature (computed over the full year) for at least three consecutive days	9
Cold wave	ColdWaveDays: Average number of days per year in which the daily mean temperature does not the 10th percentile daily mean temperature (computed over the full year) for at least three consecutive days	1
Drought	The number of years in the period of record in which the Standardized Precipitation Evaporation Index (using a 12-month drought definition) is less than -1 (computed over of the entire time series including present and future climate)	
	The number of years in the period of record in which the Standardized Precipitation Evaporation Index (using a 36	

Collaborative Definition/Development ~160 indices

Index D 2

Ports

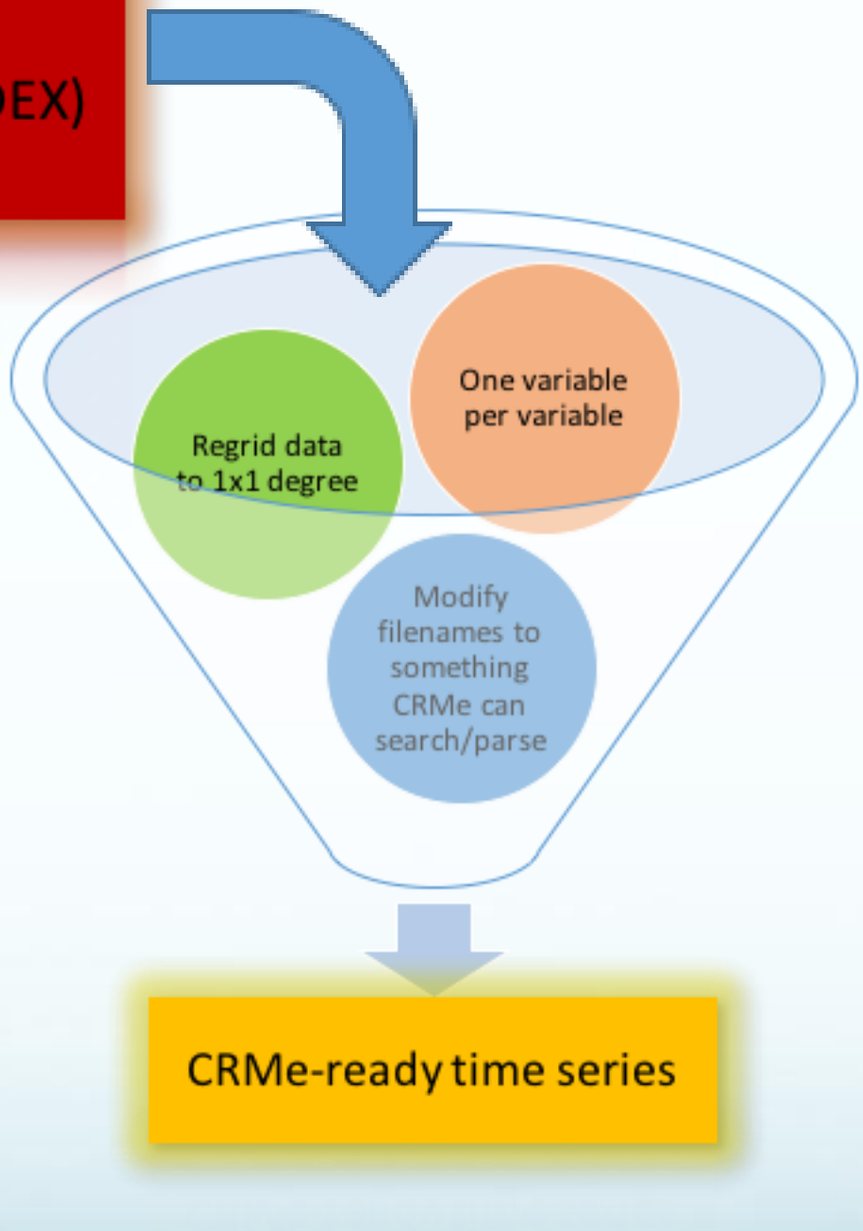
Forestry

Insurance

CRMe : “Climate Risk Management engine”

efficiency, flexibility, extensibility, …

Broad input data:
- raw models (GCM, RCM),
- compillations (CMIP5, CORDEX)
- observational datasets



Input: Climate variables

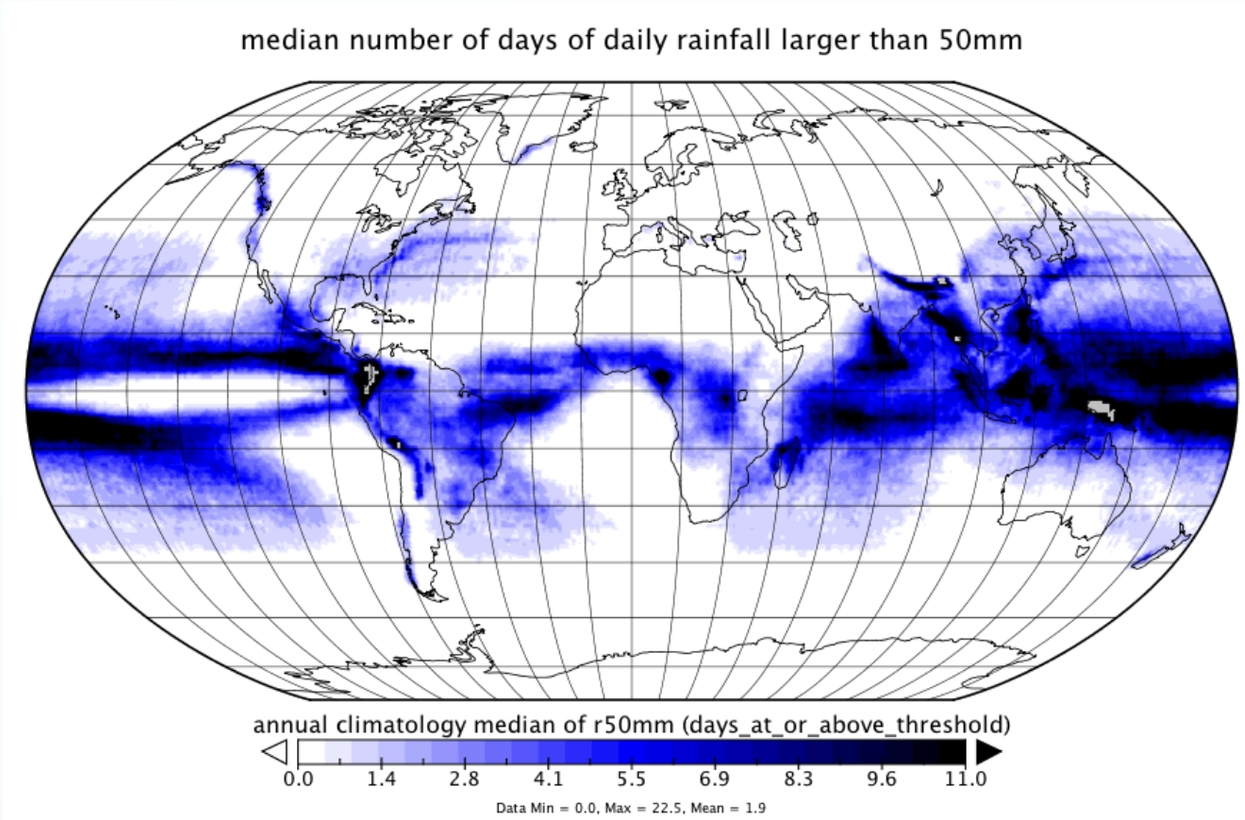
- tas
- tasmin
- tasmax
- pr
- uas
- vas
- rhs
- psl
- huss
- …

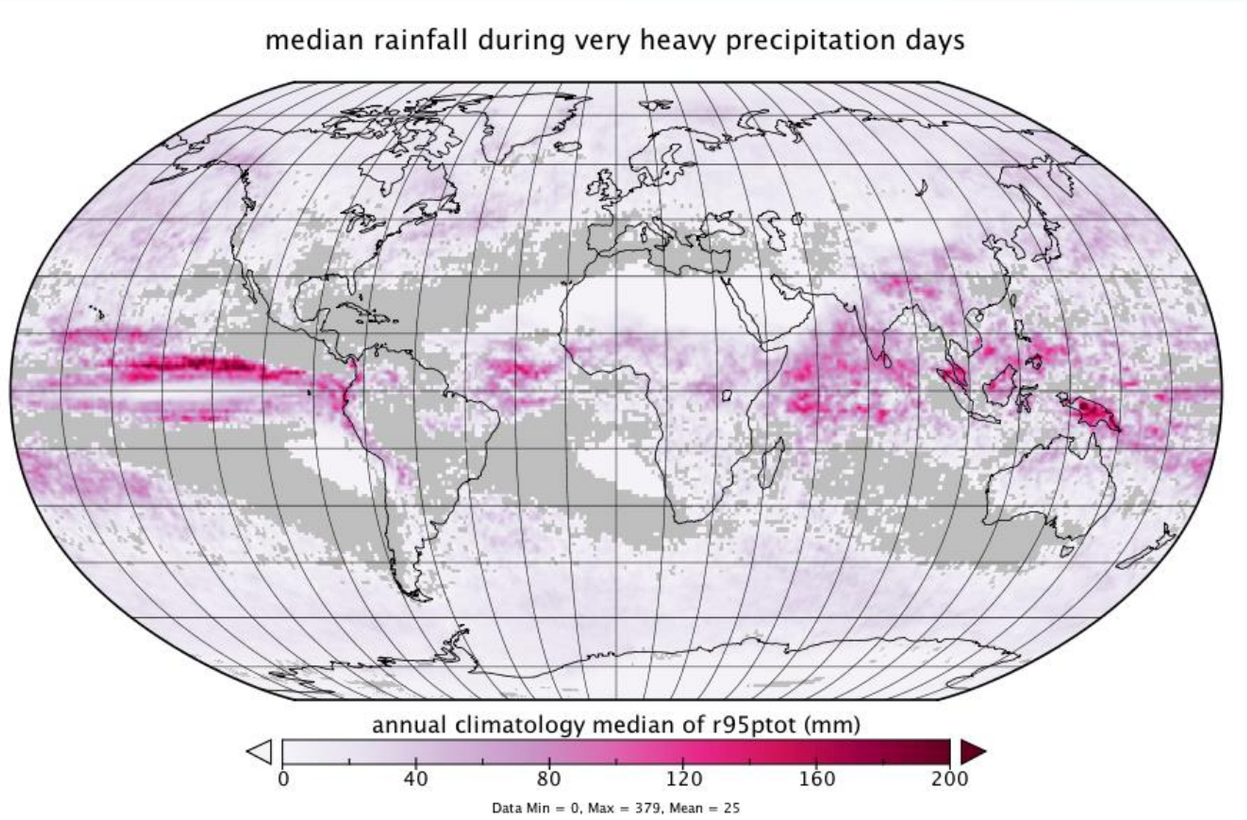
Output: Climate indices

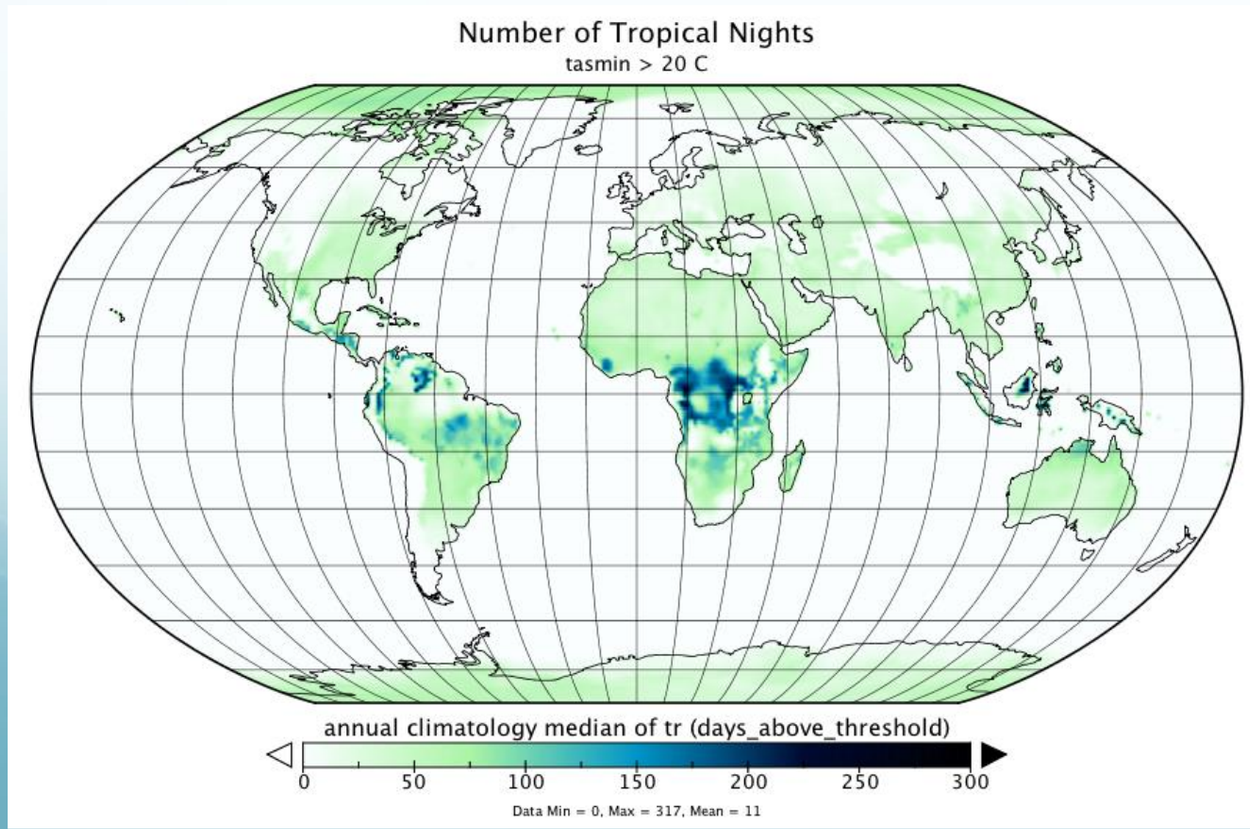
- climatological fields
- sectoral indices
  - health indices
  - agricultural indices
  - water sector indices
  - insurance indices
  - transportation / ports
  - energy
  - …
- diverse climate statistics
- ensemble information
- comparison options

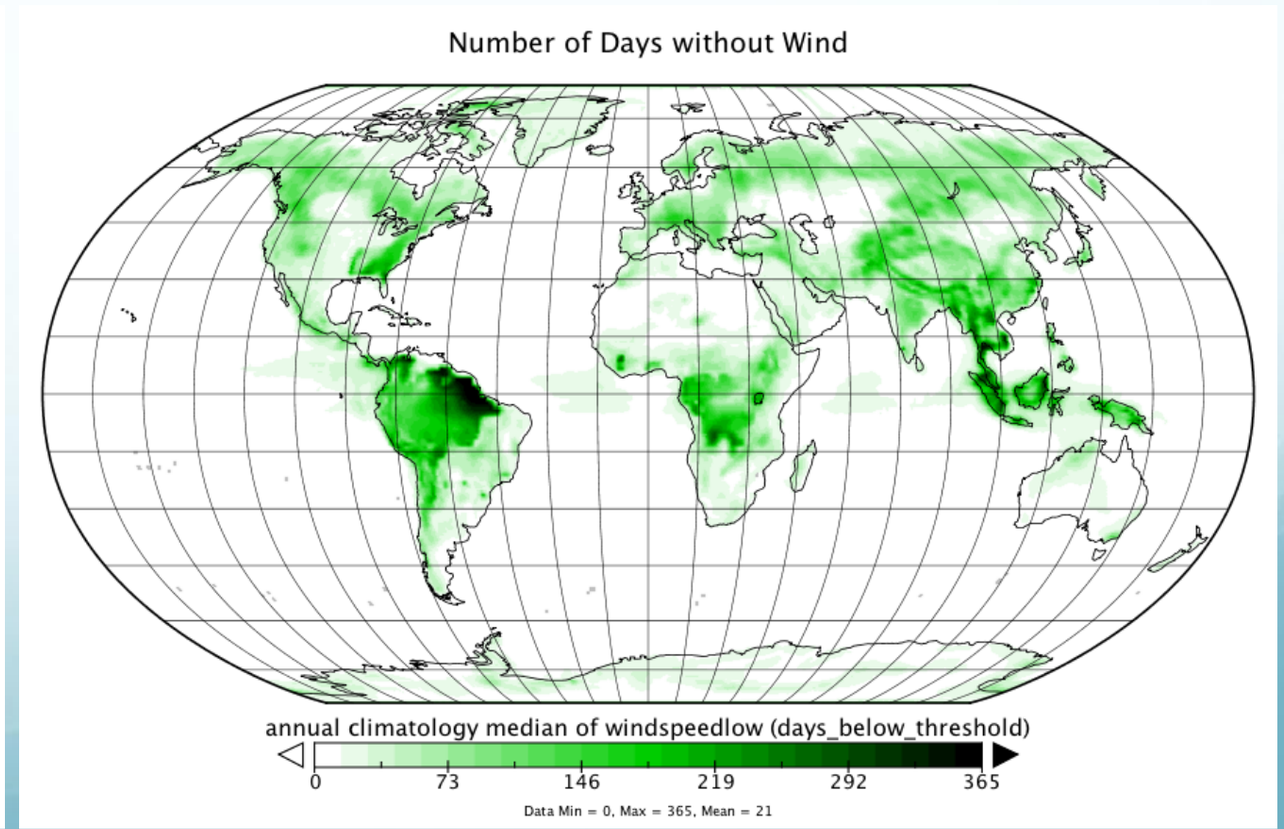
Diversity of Climate Indicators

for analysis platforms, screening tools and dashboards

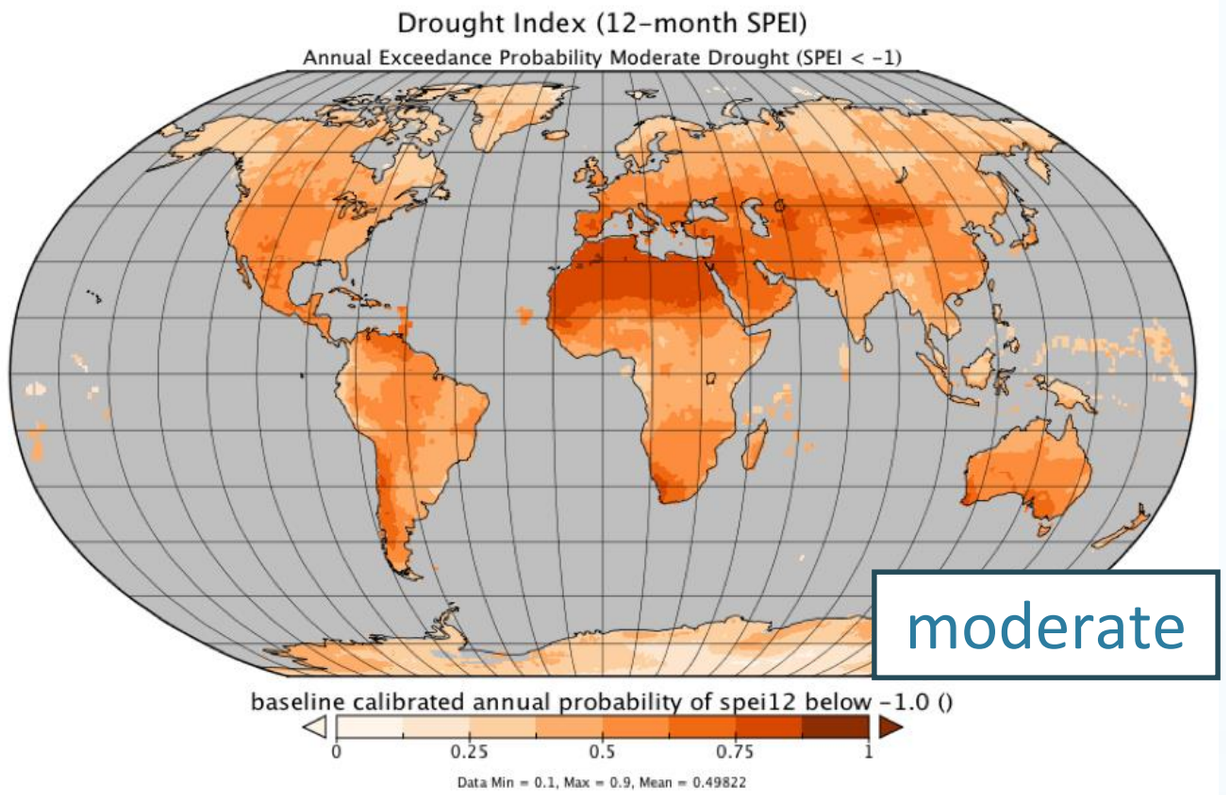




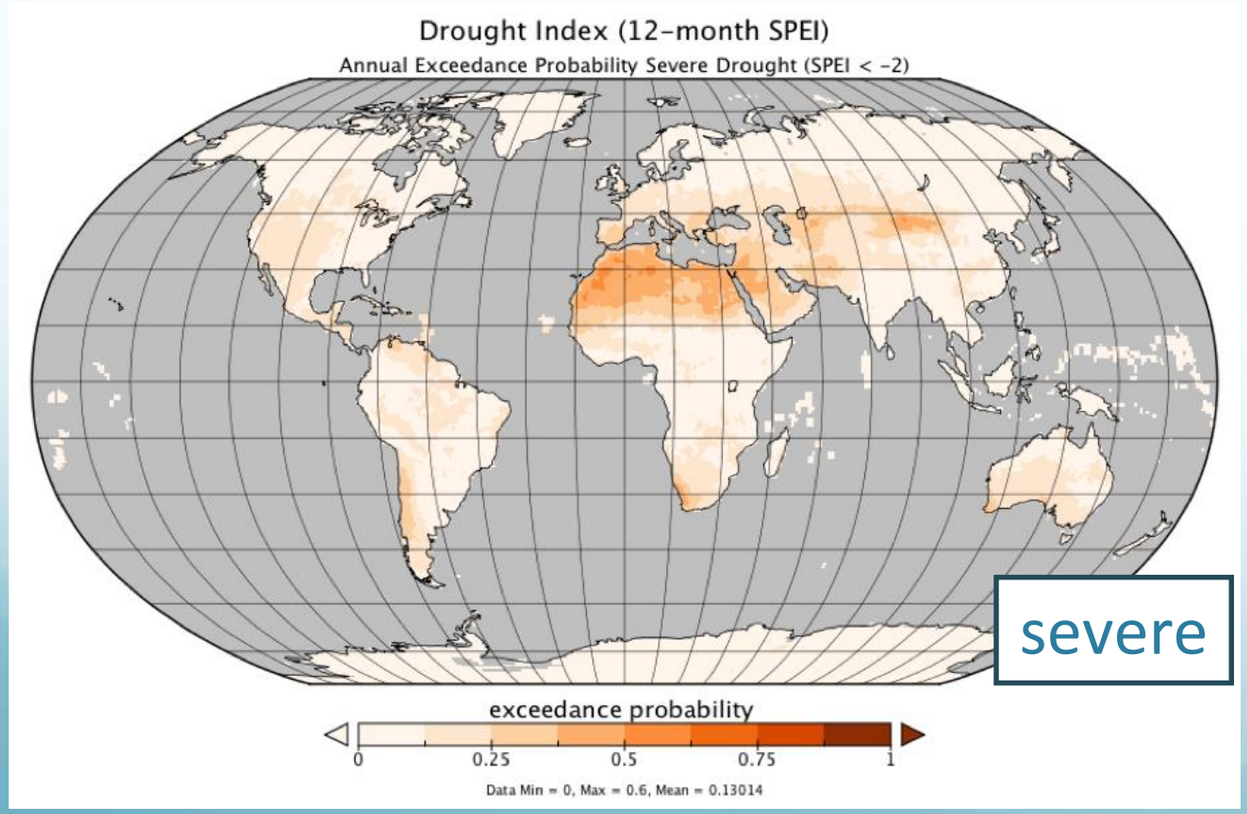




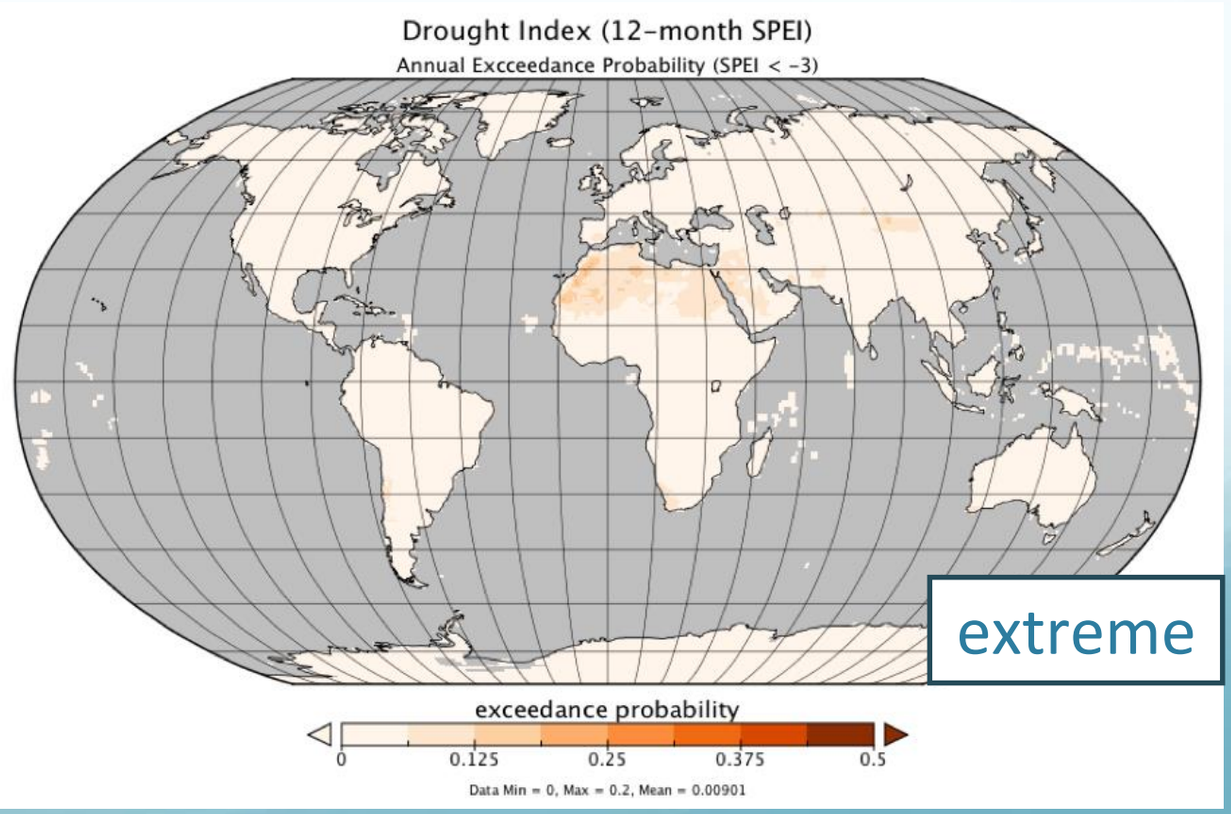
Change in annual likelihood for drought by 2035



moderate

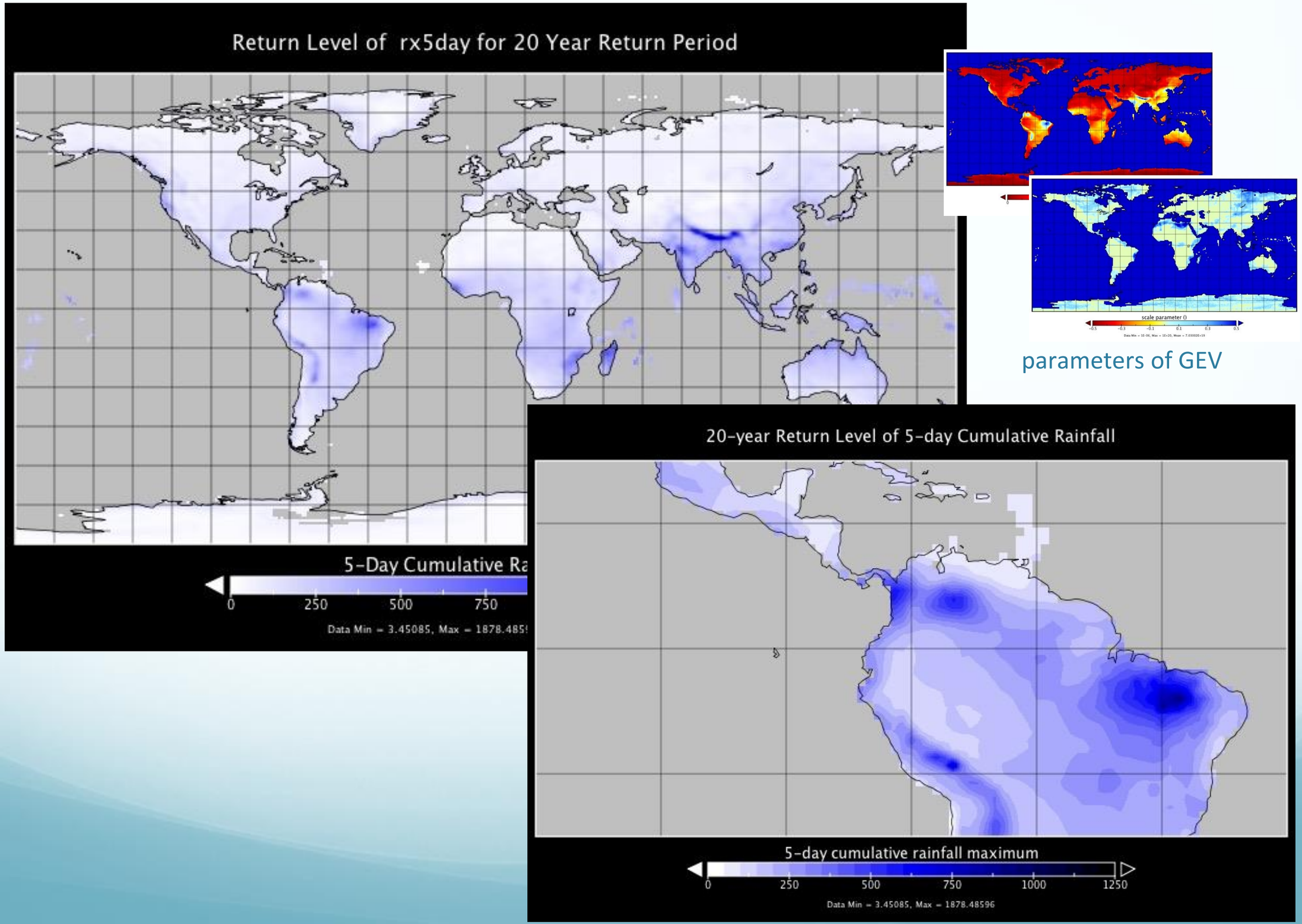


severe



extreme

Extreme Rainfall: 5-day cumulative rainfall – 20-yr return levels

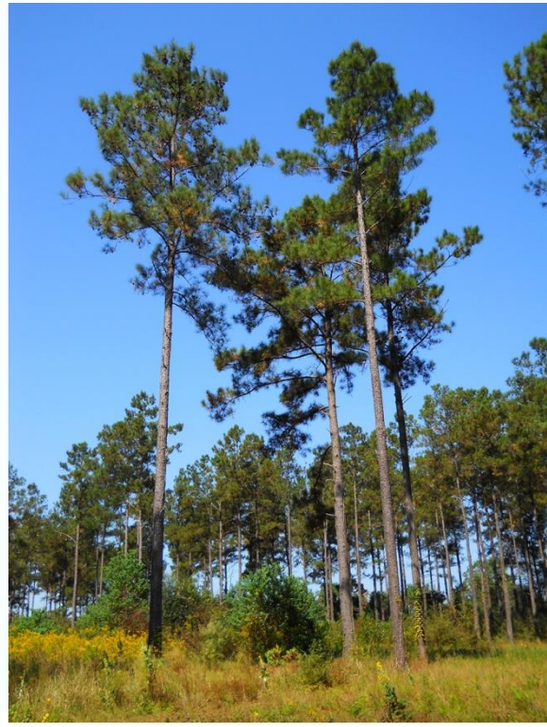


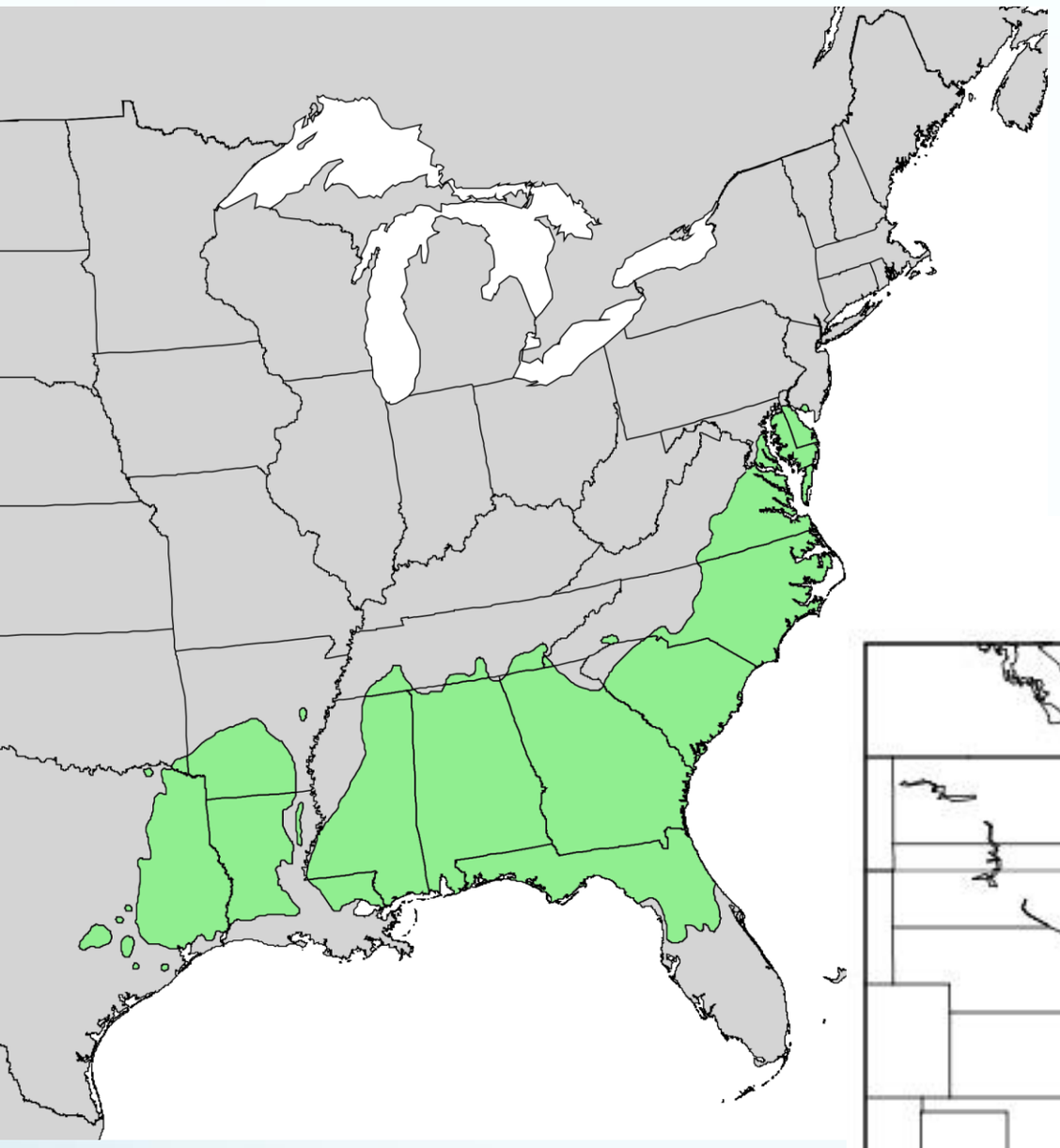
parameters of GEV

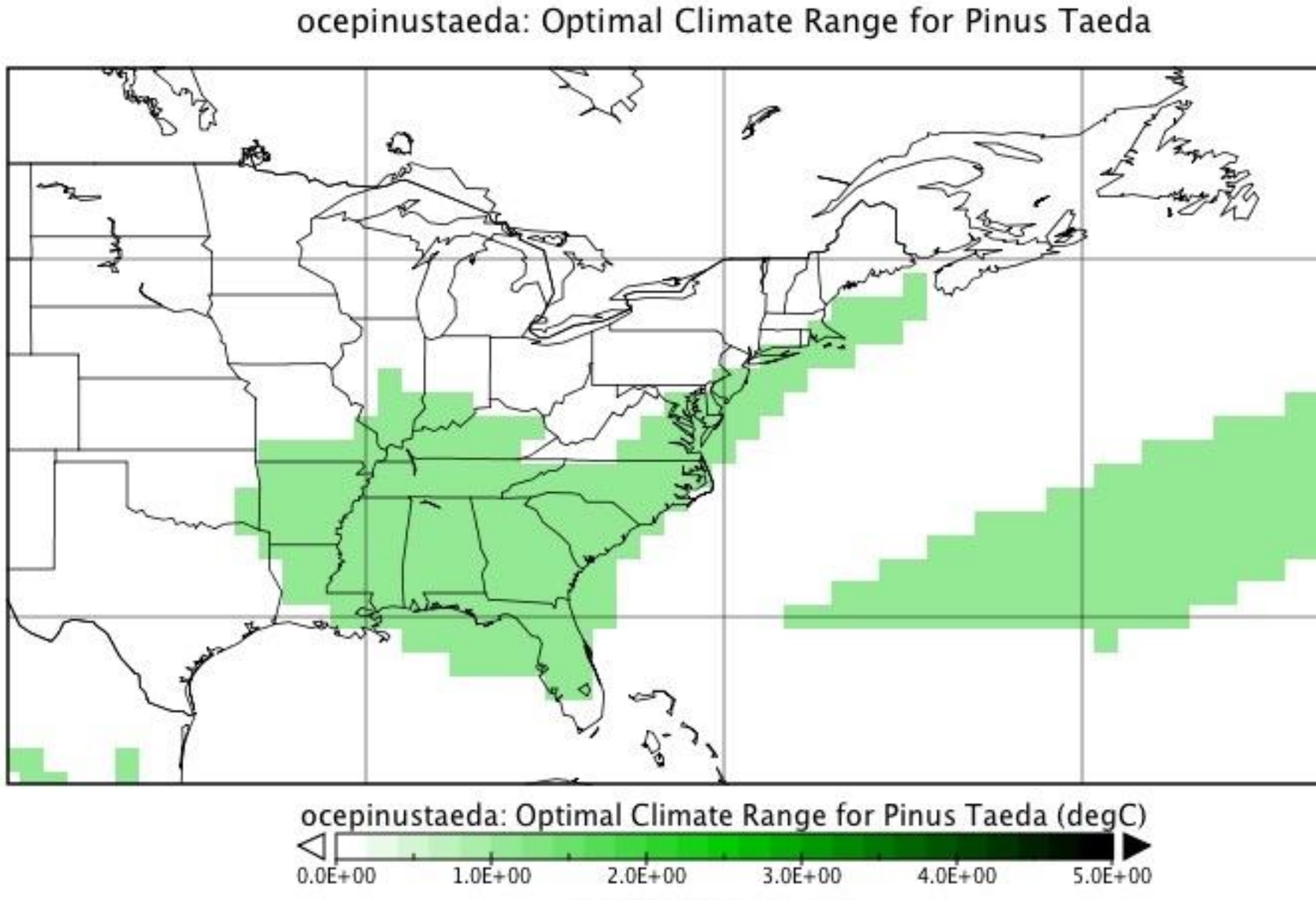
NCAR

Suitability of Pinus Taeda

(example CCSM4)

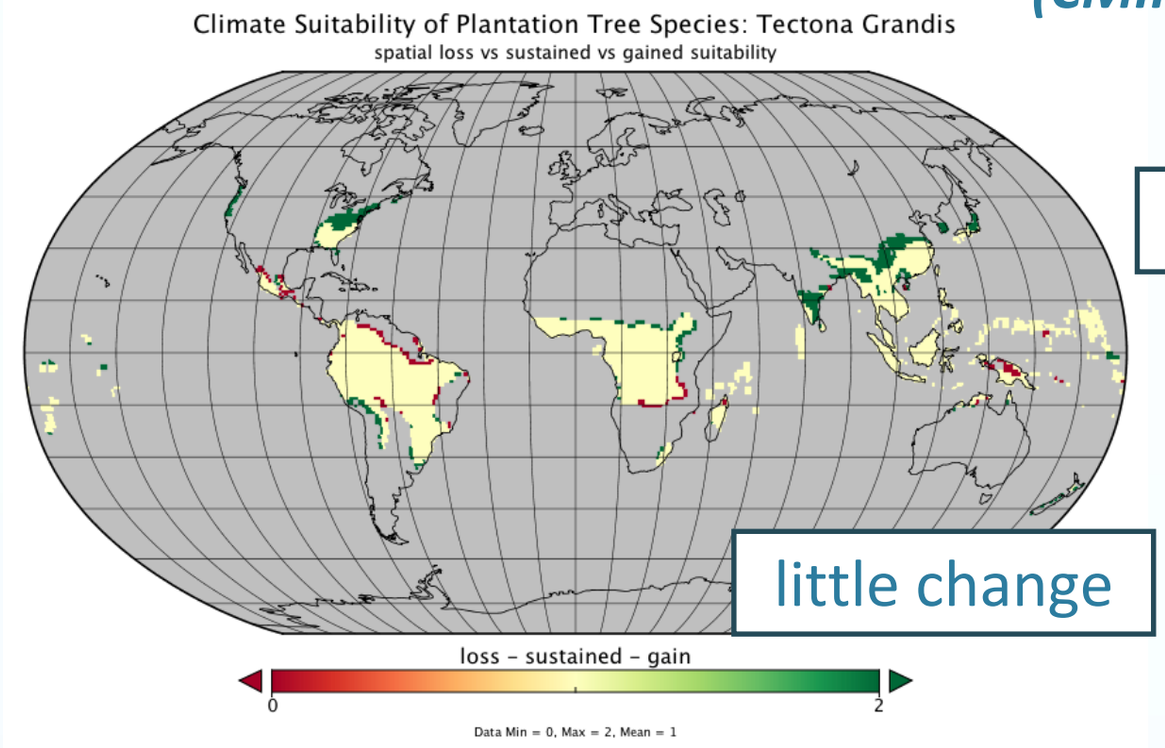




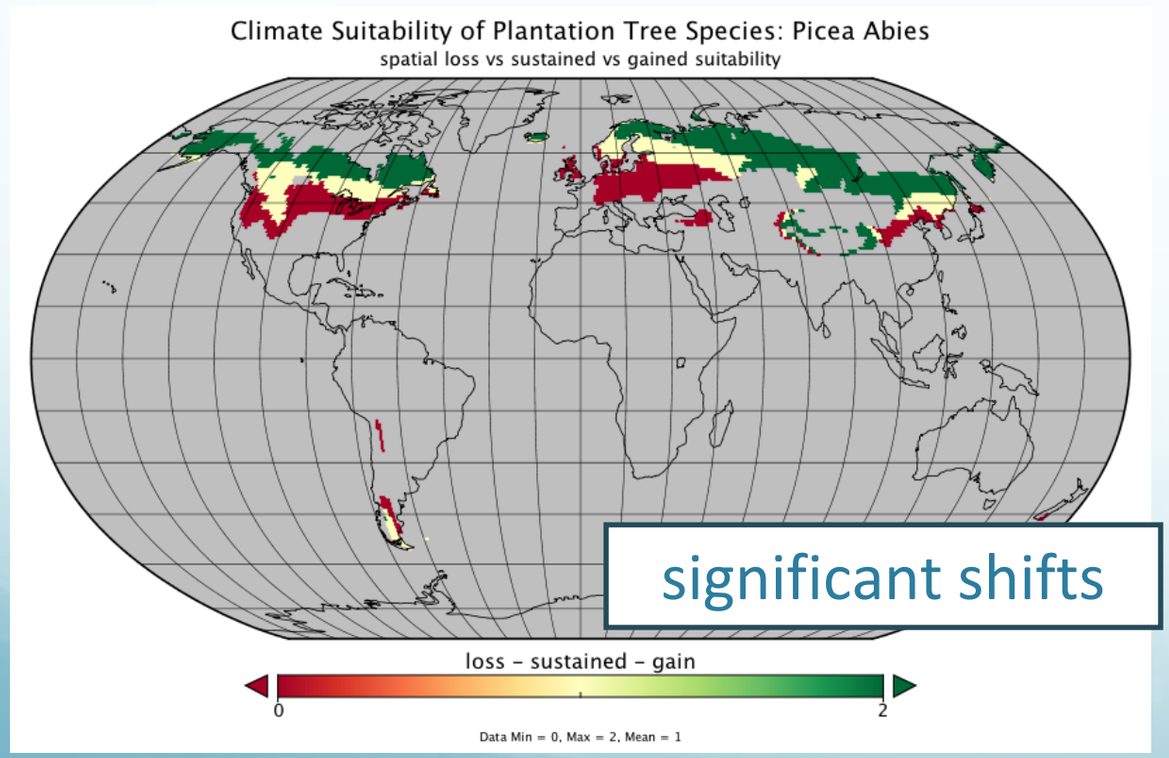


Changes in Suitability of Plantation Tree Species

(CMIP5 ensemble)

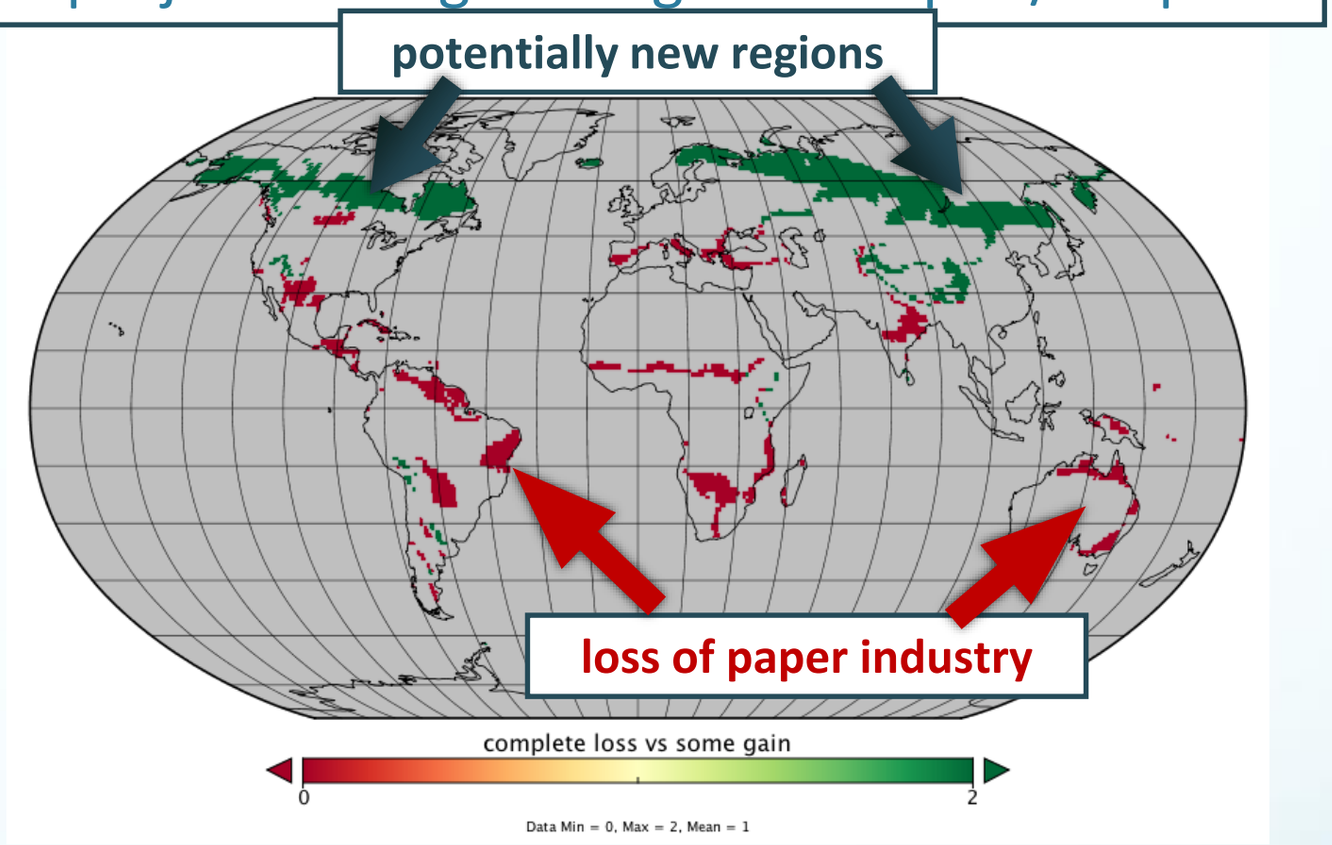


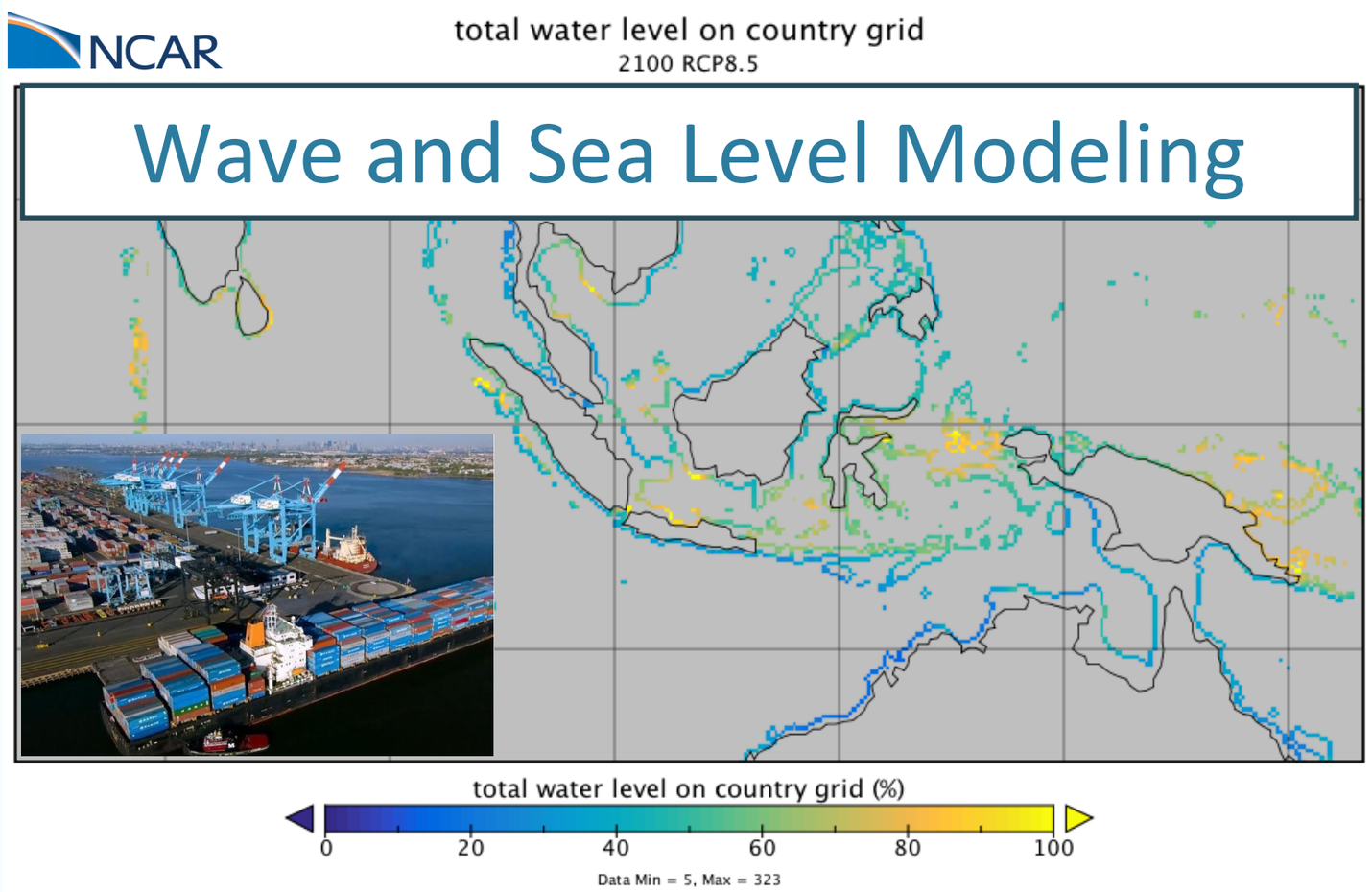
little change



significant shifts

projected range changes for Paper / Pulp

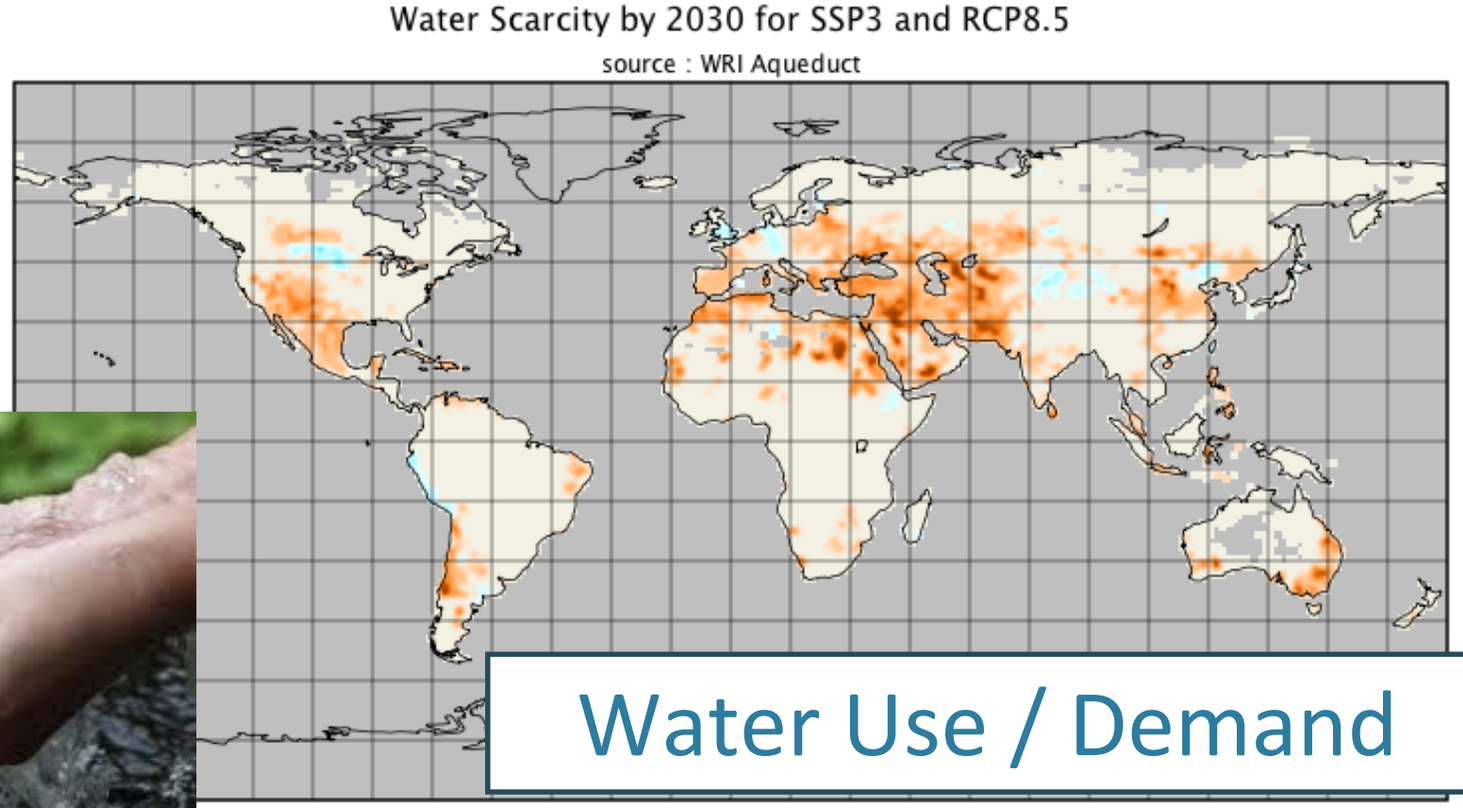




Challenges

need for expanded capabilities

- *wave and sea level*
- *integrate human components*



Dashboards : Sector specific

ral.ucar.edu

Read Now | Varia | News | NCAR | Journals | SEARCH | CentralAmerica | CESM-SDWG | NewCRM

Coffee And Climate Change: In Brazil, A Disaster Is Brewing : The Salt : NPR | CCKP Dashboard

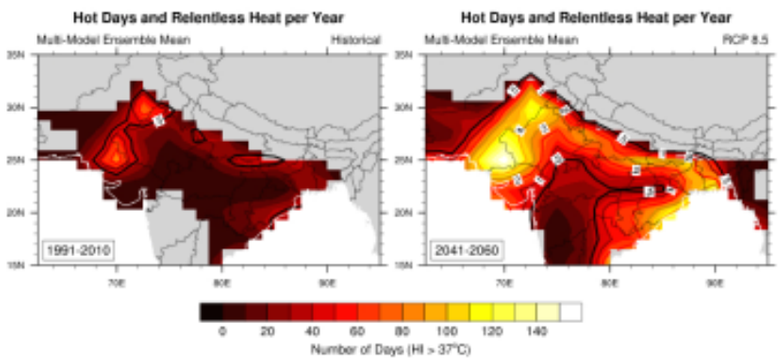
NCAR-RAL Home

INDIA

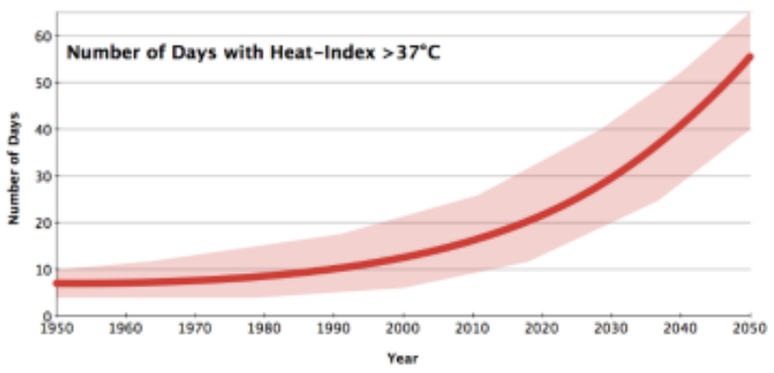
HEALTH SECTOR: HEAT HAZARD

Click on Images to Enlarge.

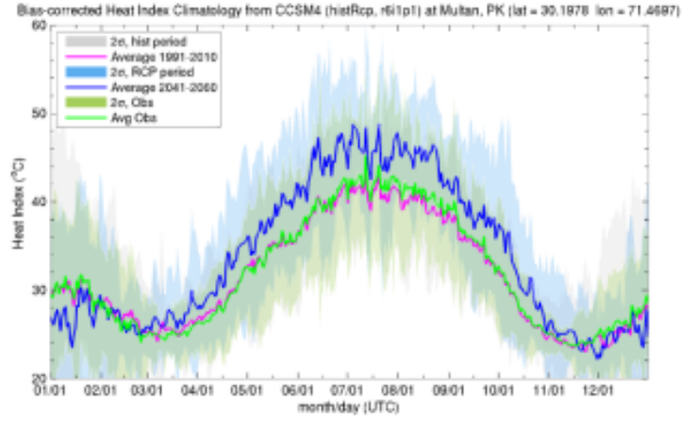
Map



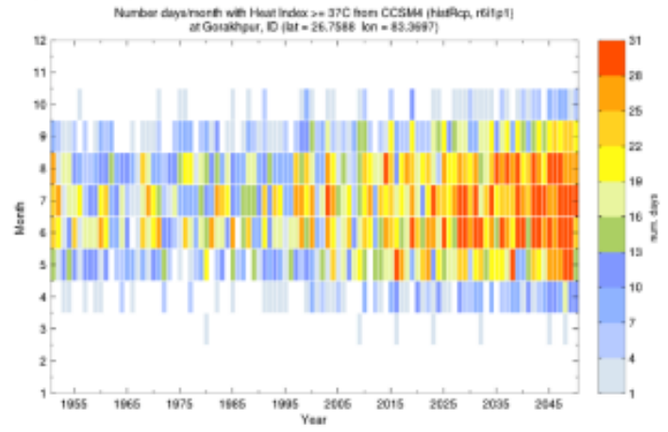
Time Series



Seasonal Cycle



Frequency



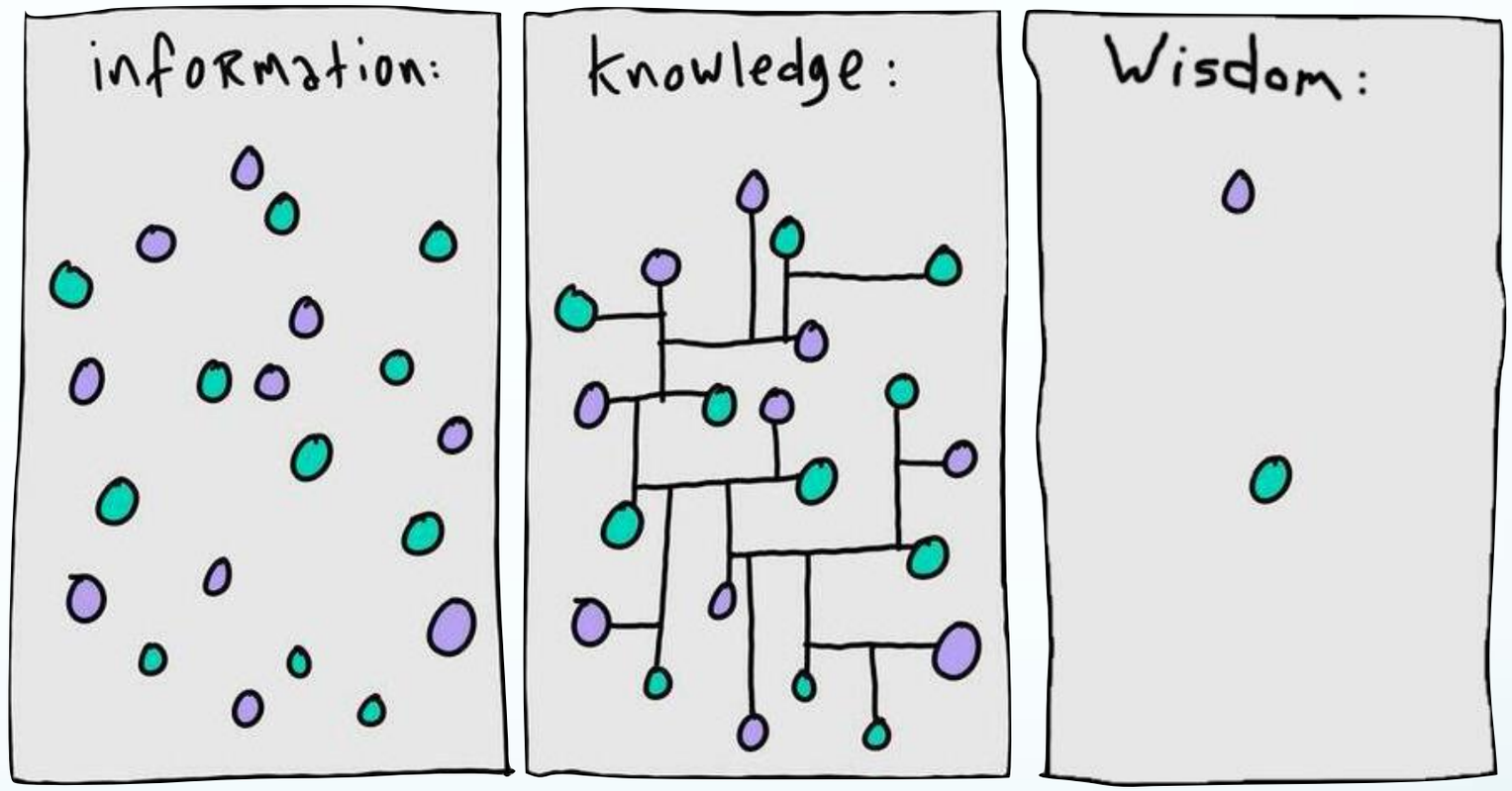
Summary

Narrative:

Risig temperatures will pose elevated risk for people around the world. However, taking into account moisture is important to link to human health. High temperatures combined with high atmospheric moisture can prevent the human body to balance its temperature through transpiration. The simple heat index is one of many measures of this risk to human health.

x-ray : data quality evaluation

data



Data archives

accessible,
standardized,
…

Information Portals

quality control,
use-oriented,
…

Interactive Platforms

translated,
put in context,
…

Communities of Practice

robust,
embedded,
…

CRMe Summary

- Develops indices/indicators from “bottom-up” needs of practitioners, implemented through discrete, structured, “top-down” workflows for rapid delivery
- Web-based data services to deliver usable climate info
- Dashboards for quick, user/application-specific summaries of climate info
- 200+ application/sector-oriented climate indices/indicators
  - 27 core Climate Extremes (ETCCDI) indices
  - Human health, heat, ecological indices
  - Return period-based indices (flood, drought, fire, TCs, …)
  - “Nice”/“miserable” weather indices
- **We welcome partnerships with climate data users, social scientists, policy and decision-makers, risk practitioners, and commercial interests to expand CRMe capabilities!**

Thanks! Any Questions?

Jonathan Vigh — email: jvigh@ucar.edu
Caspar Ammann — email: ammann@ucar.edu
Jared Lee — email: jaredlee@ucar.edu

NCAR

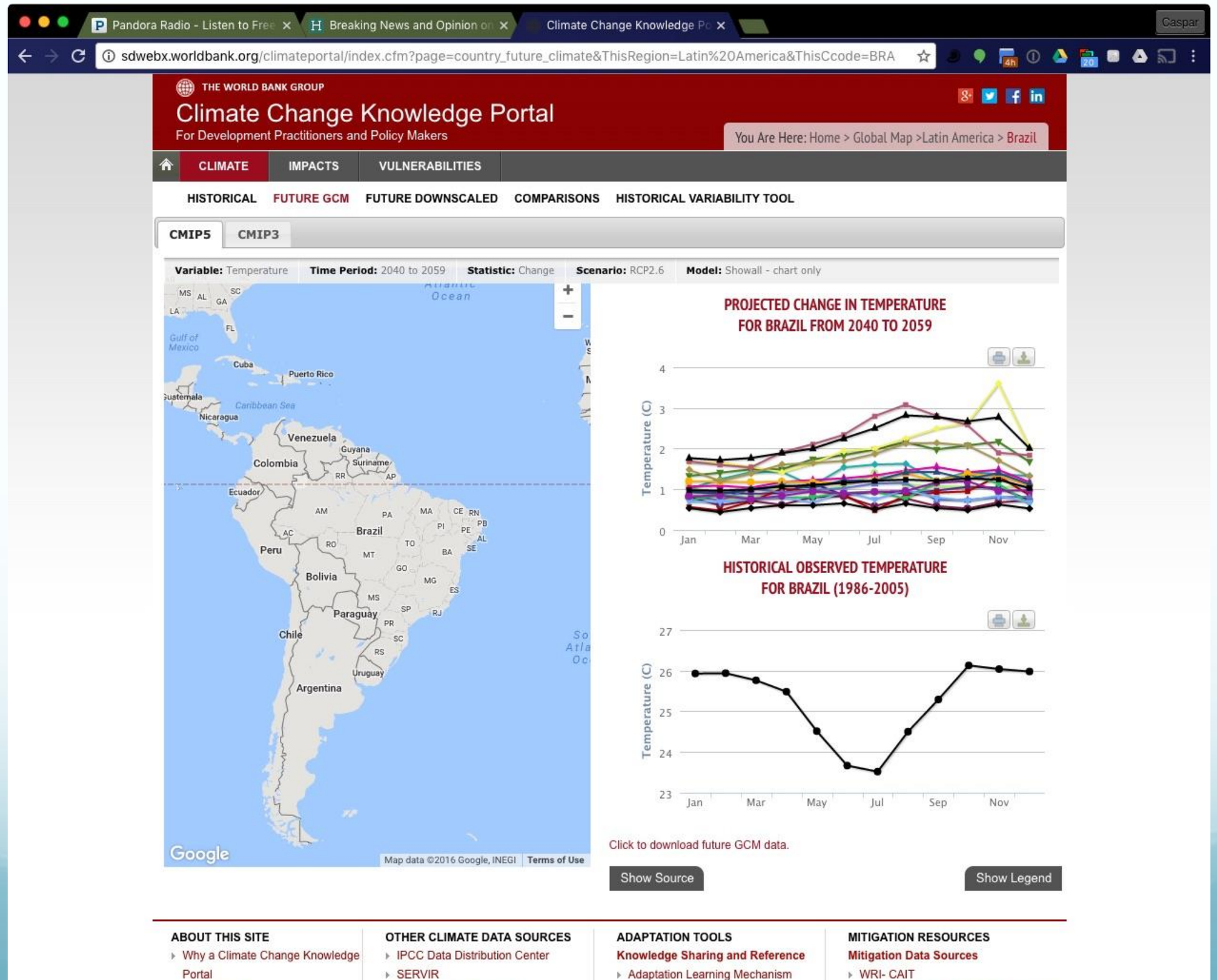
Climate Risk Management for Adaptation — Main Objectives

Deliver, evaluate and translate sound, past-present-future climate science to decision makers to identify and address adaptation needs, to promote sustainability, and to reduce human system vulnerability to regional climate variability/change.

- ***Climate Data Evaluation:*** Implement a capability to compute transparent, standardized metrics that offer application-oriented information about quality of data and their uncertainties.
- ***Usable Climate Science:*** Develop the scientific basis for co-developing sound climate data and information services in critical end-use domains (e.g., agriculture, urban, and natural resource planning).
- ***Scenario Environment for Integrated IVA Studies:*** Define a protocol for interdisciplinary engagement through quantitative scenario development and testing of the effectiveness of climate-adaptive interventions
- ***Climate Change Capacity Building:*** Define and develop modular science content and tools to assist in the translation of climate science information to support multi-directional capacity building and decision-making in context of extreme societal vulnerability

Example *"top-down"* Data & Information Portals

Building on standardized data: offering broad information



Common Challenges

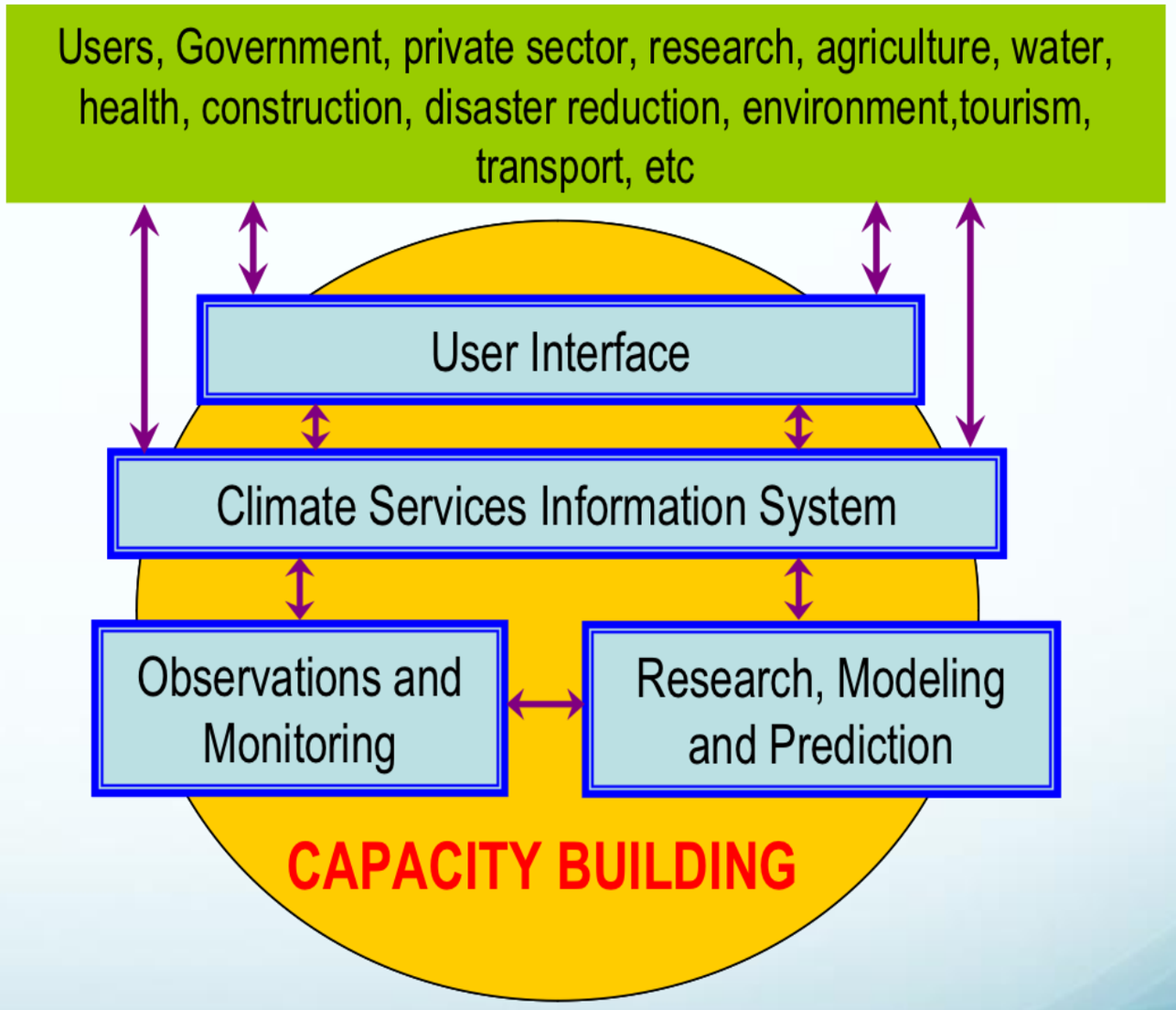
Important foundations, but limitations in usability and usefulness

- **Top-down:** generalizes information, might not be applicable for many needs, …
- **Bottom-up:** describes local needs, ignores larger context, unaware of realistic projection information, …

WMO - GFCS

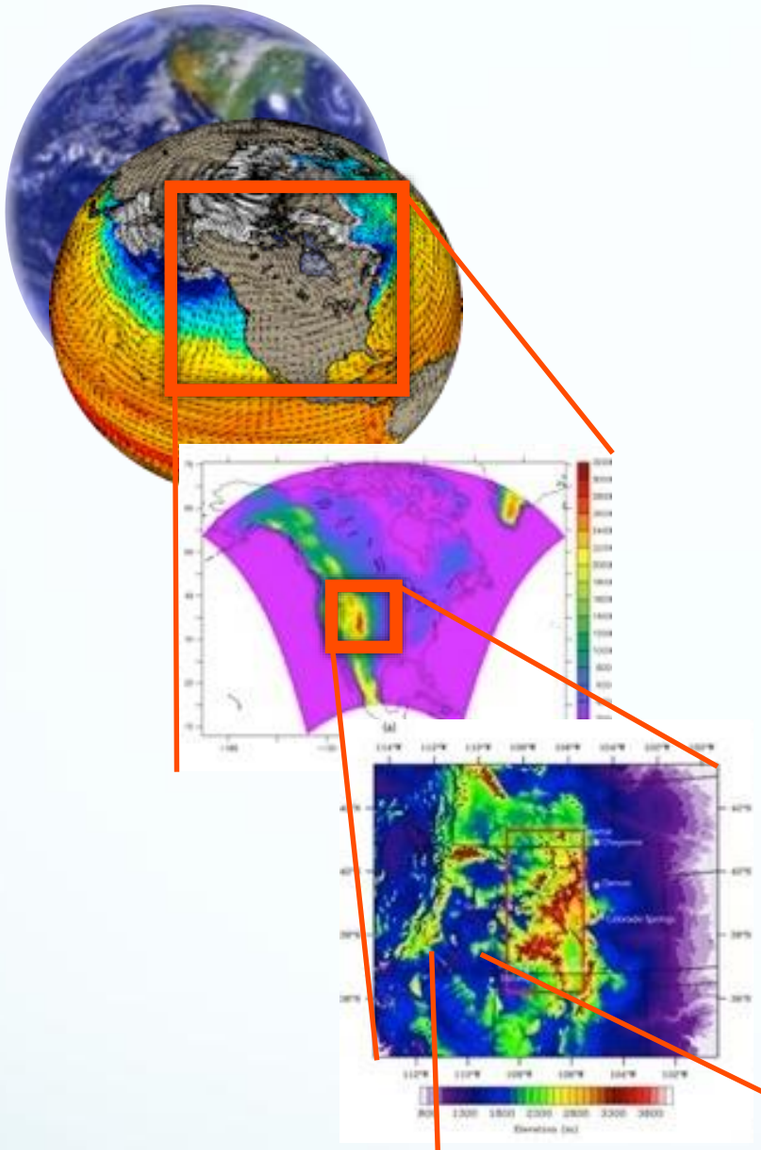
Global Framework for Climate Services

- **User Interface Platform**
  - A means for users, user representatives, climate researchers and climate service providers to interact
- **Climate Services Information System**
  - To collect, process and distribute climate data and information according to the needs of users and according to the procedures agreed upon
- **Observations and Monitoring**
  - To ensure that the climate observations necessary to meet the needs of climate services are generated
- **Research, Modeling and Prediction**
  - To assess and promote the needs of climate services within research agendas
- **Capacity Building**
  - To support systematic development of the necessary institutions, infrastructure and human resources to provide effective climate services.



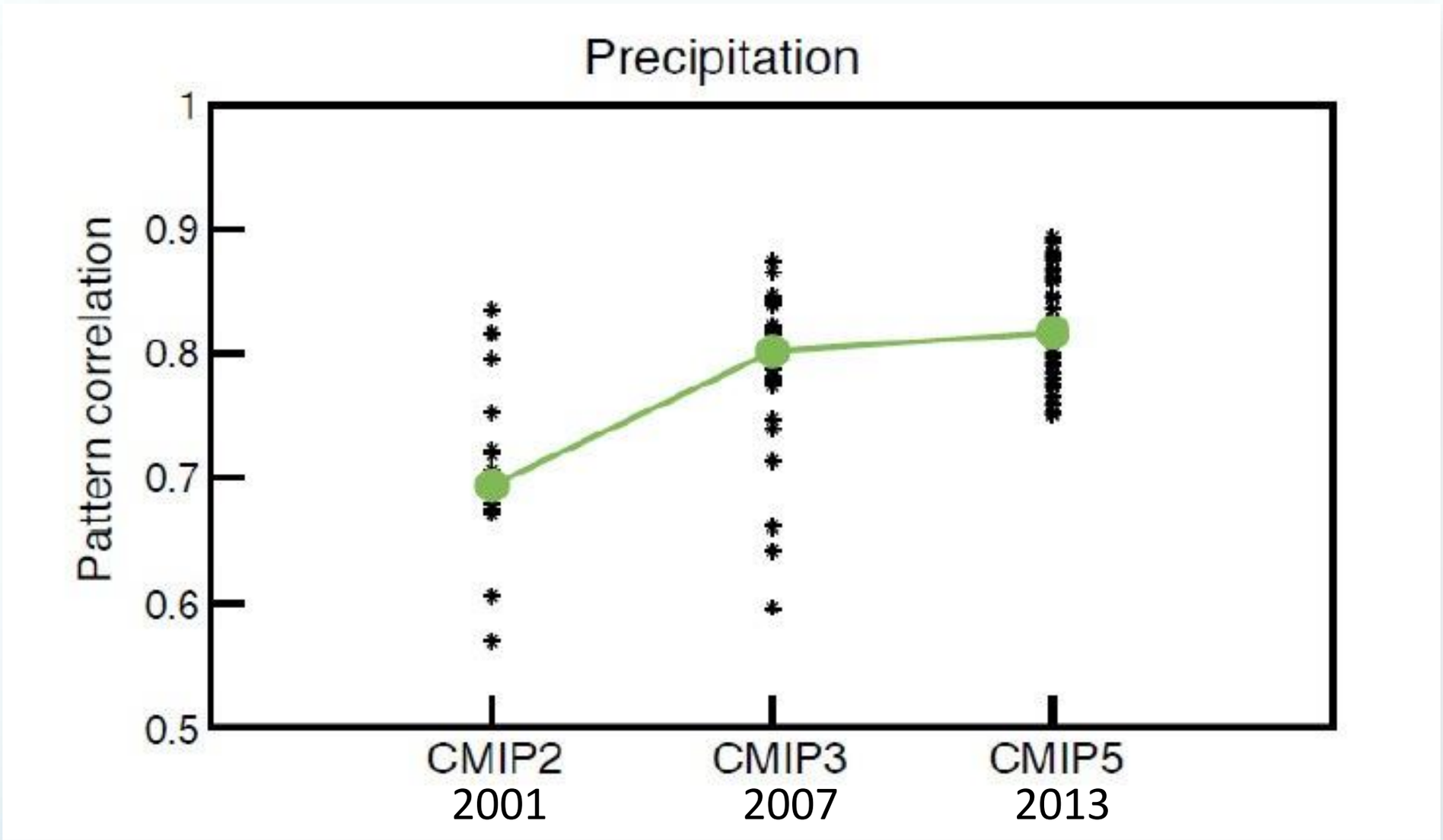
New Focus on Regional Climate and Impacts

Integration of data and knowledge across scales.
Global - to - Local



e.g.: Agriculture

Validation: Skill of Models

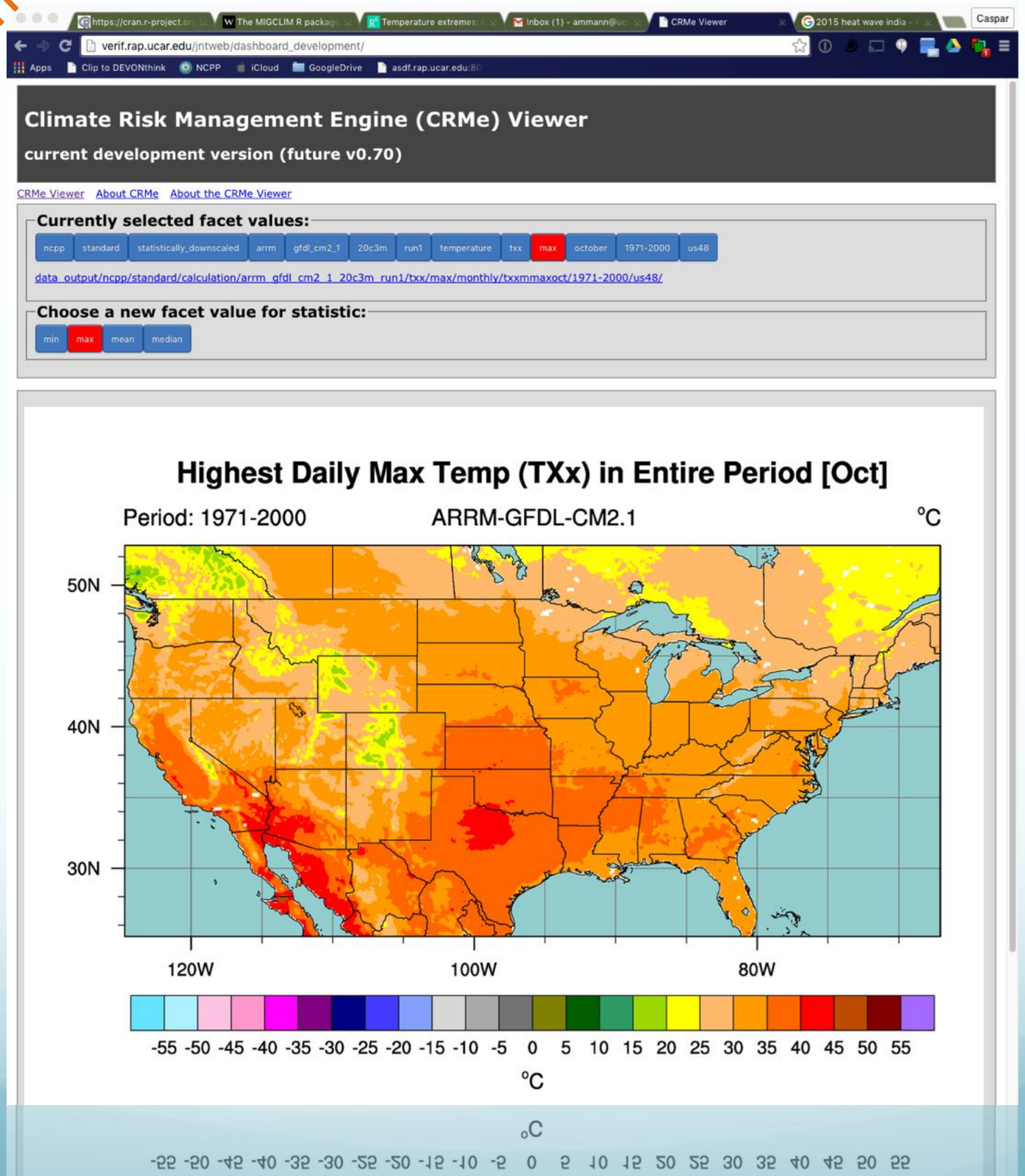


IPCC Model “Spatial Skill”: Pattern Correlations

Indices, statistics, metrics: “CRMe”

http://verif.rap.ucar.edu/jntweb/dashboard

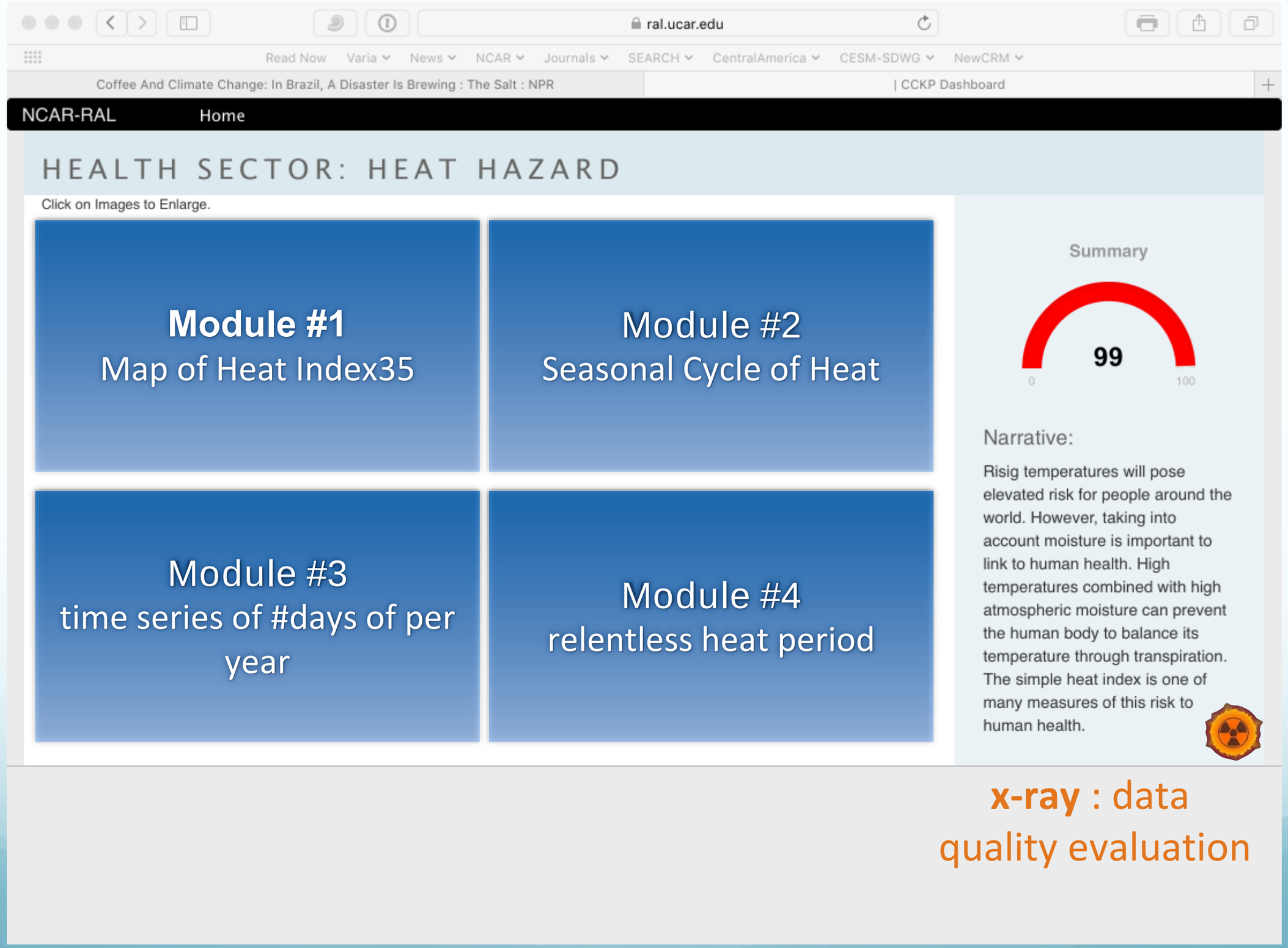
Under Development



Implemented by:
Jonathan Vigh

Modular Dashboards

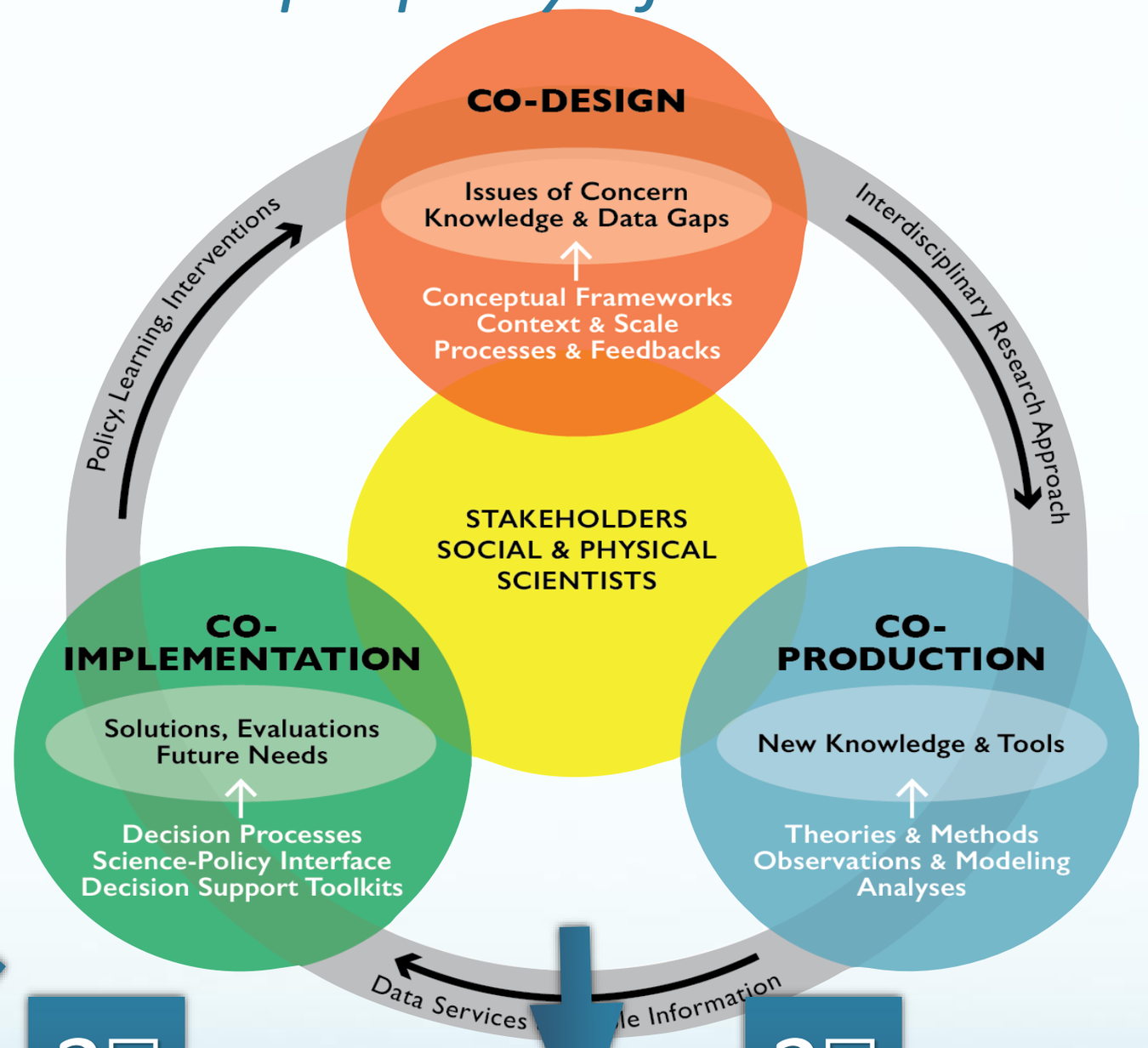
Rapid tailoring to different specific needs



x-ray : data quality evaluation

Levels of Integrated Approaches

with the common property of iterative co-development



3?

Collaborative Work and Scientific Exploration Platform

2?

Data and Information Services embedded in **Screening Tools**

1?

Application-oriented communication tools and **Dashboards**

NCAR CRMe
Climate Data Processing Steps

of CMIP5 data from raw archives
to screening tool products